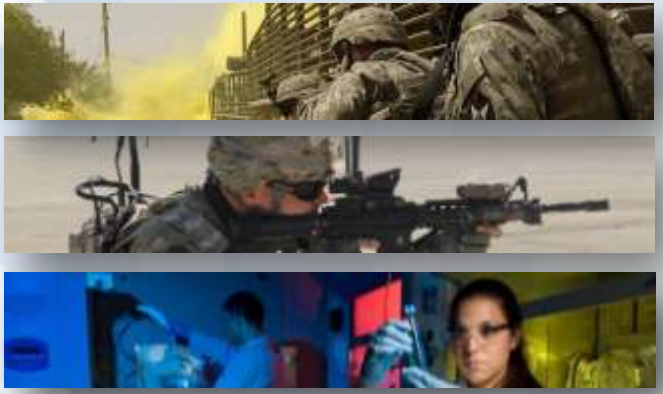
Army Science & Technology

Air Portfolio Overview



Mr. Todd M. Turner
Director Air Portfolio
Office of the Deputy Assistant Secretary of the Army for Research and Technology

DESIGN • DEVELOP • DELIVER • DOMINATE
SOLDIERS AS THE DECISIVE EDGE

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Air Portfolio Vision/Mission Statement

Vision

Be the global leader in providing game-changing range, payloads, speed, survivability and lethality to maintain U.S. technical superiority and combat overmatch for vertical lift aviation systems

Mission Goals

- **Longer Persistence**
- **Longer Range**
- **Larger Payload**
- **Increased Speed**
- **Combat Overmatch**
- **Battlefield Dominance**
- **Lower Cost of Ownership**

Best technology for current and future platforms at the right time at an affordable cost

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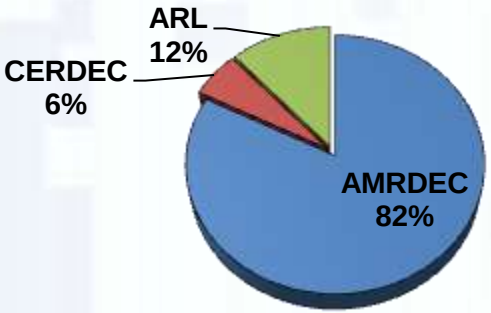
FY14

Air Portfolio

Air Portfolio
6.2 and 6.3 Funding

$165M



Platform Design & Structures	Engines & Drive Trains	Aircraft & Occupant Survivability	Maintain & Sustainability	Rotors & Vehicle Management	Aircraft Weapons & Sensors	Unmanned & Optionally Manned Systems
$45M	$22M	$34M	$8M	$16M	$18M	$22M
Investment Areas •Advanced Aircraft Design •Structures •National Rotorcraft Tech Center	**Investment Areas** •Engines •Drive Trains	**Investment Areas** •Degraded Visual Environment •Signature Management •Threat Warning & Jammers •Vehicle Hardening	**Investment Areas** •Health Usage Monitoring	**Investment Areas** •Rotors •Vehicle Management Systems	**Investment Areas** •Cockpit Displays •Sensors •Weapons	**Investment Areas** •Autonomy •Human/ Machine Interface •Unmanned Aerial Vehicle Sensors

Source: Army Science and Technology Management Information System (ASTMIS) PB14

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Platform Design & Structures Sub-Portfolio

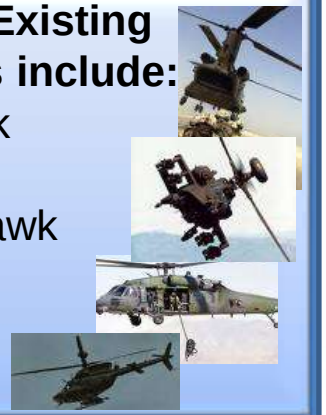
Goal: Provide unmatched vertical lift aircraft performance to meet future operational capabilities

S&T Major Efforts include:
- Joint Multi-Role Demonstrator
- Air Vehicle Design Methods
- Collaborative Govt/Industry Research

Near-term Goals:
- Replace empirical methods in early aircraft design tools with first principals models suitable for new aircraft configurations
- Develop structural materials and investigate damage mechanisms for improved durability
- Investigate advanced vertical lift aircraft concepts that meet future operational requirements

Mid/Far-term Goals:
- Design and fabricate full-scale aircraft to flight demonstrate joint service defined vehicle performance
- Integrate mission equipment elements into aircraft to flight demonstrate joint service defined operational capabilities

Legacy/Existing Systems include:
- Chinook
- Apache
- Blackhawk
- Kiowa



Internal Stakeholders:
- AMRDEC
- ARL

External Stakeholders:
- PEO-Avn, Platform PMs
- PM-ASE
- G-3/5/7 Aviation, G-8
- Navy/USMC
- TRADOC

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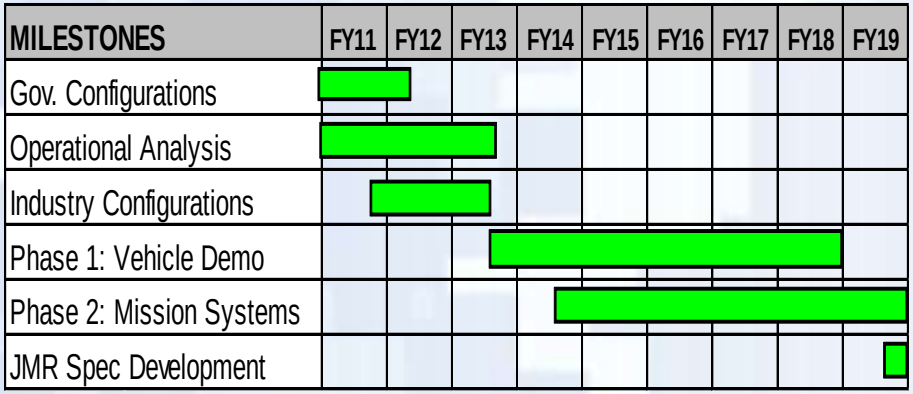
Joint Multi-Role Technology Demonstrator

Purpose:
Demonstrate transformational vertical lift capabilities to prepare the DoD for decisions regarding the replacement of the current vertical lift fleet

Results/Products:
- Demonstrated and refined set of technologically feasible and affordable capabilities
- Technology maturation plans
- Cost analysis for future capabilities
- Two demonstrator aircraft

Payoff:
- Reduced risk for critical technologies
- Acquisition workforce with improved skill sets to develop specifications and analyze technical data
- Data readily available to support future DoD acquisitions

Schedule



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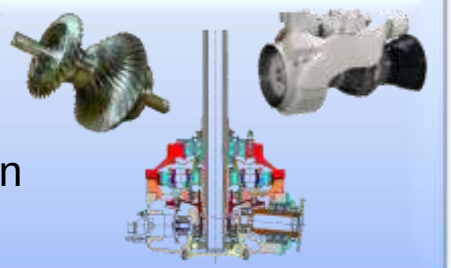
Engines & Drive Trains Sub-Portfolio

Goal: Provide increased power density to meet vertical lift operation requirements while reducing fuel usage

S&T Major Efforts include:
- 3000 shp turbine engine
- 7000 shp turbine engine
- Advanced high power density transmission



Near-term Goals:
- Develop turbine engine with 25% reduced fuel burn and 35% reduced production and maintenance costs (medium fleet)
- Develop turbine engine with 35% reduced fuel burn and 45% reduced costs (heavy fleet)
- Develop high power density transmission with 55% increased hp/wt and 35% reduced production and maintenance costs

Mid/Far-term Goals:
- Develop turbine engine with broad, high efficiency operating speed envelope
- Develop lightweight, durable multi-speed/variable speed transmission to provide variable output speed

Legacy/Existing Systems include:
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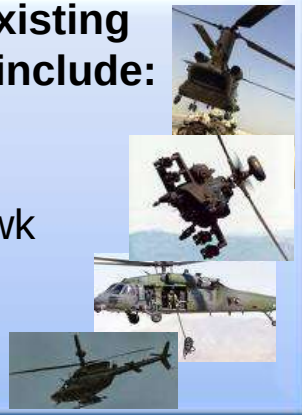
- Apache
- Blackhawk
- Kiowa



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- VAATE

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Future Affordable Turbine Engine (FATE)

Advanced Technology Turboshaft Engine

Goals:

- 35% SFC
+80% Hp/wt
- 45% Cost

Schedule

MILESTONES	FY12	FY13	FY14	FY15	FY16
Aero, Mech Designs	4				
Fabrication					
- rig hardware					
- engine hardware					
Component Rig Tests			5	5	
- compressor, combustor					
- turbine, mech systems					
Engine Tests					
- performance, durability					6

Purpose:

Develop advanced, affordable turboshaft engine featuring versatile component technologies providing significant improvement in operational capability for current and future force rotorcraft

Products:

- Full system demonstration of high performance, high efficiency turboshaft engine with advanced materials and cooling technologies incorporated into a robust, light weight architecture
- Technology readiness to allow transition to engine program for CH-47 upgrades and Future Vertical Lift (FVL) tech insertion
- Enhanced software design tools to support engine development efforts

Payoff:

- Significant range and payload capability enhancements for future force rotorcraft
- 45% Reduction in Production and Maintenance Cost
- Reduced logistic footprint
- Other Applications: SOF MH-47, CH-53, Global Hawk, V-22, C-130

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Aircraft & Occupant Survivability Sub-Portfolio

Goal: Provide overmatching protection of the aircraft and occupants from the full spectrum of threat weapons & environments

S&T Major Efforts include:
- Vehicle Signature Reduction
- Degraded Visual Environment (DVE) Mitigation
- Aircraft Survivability Equipment (ASE)
- Ballistic Protection and Crashworthiness

Near-term Goals:
- Enhanced situational awareness under zero light & degraded visual environments to prevent aircraft mishaps and aircrew injuries
- Signature management materials to reduce detectability of aircraft
- Lightweight, integrated ballistic armor materials
- Crashworthy airframes and component design methodologies

Mid/Far-term Goals:
- Effective airframe coating systems to manage the signature
- Integrated ASE architectures to provide plug & play capability to legacy and future ASE systems
- Improved transparent and opaque armor, crashworthy structures, and post-crash fire prevention technologies

Legacy/Existing Systems include:
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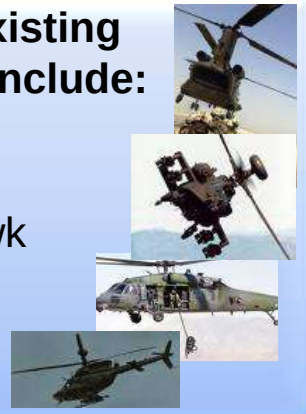
- Apache
- Blackhawk
- Kiowa



Internal Stakeholders:
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- ARL
- CERDEC

External Stakeholders:
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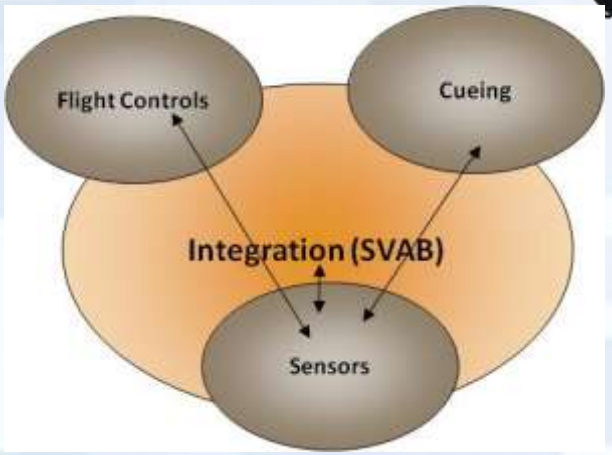
Degraded Visual Environment

Sensors

- Radio Frequency
- Laser
- Infrared
- Image Intensifiers

Symbology • Cueing • Displays

- DVE Symbology and Visual/Aural Cueing
- Tactile Cueing (TSAS)
- Displays



Handling Qualities

- A/C Performance Models
- A/C Flight Controls

Collaborative effort across the S&T community to parametrically define control system, cueing, and pilotage sensor combination(s)

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Maintainability & Sustainability Sub-Portfolio

Goal: Provide prognostic and diagnostic capabilities to move from replacement of components due to time on air frame to condition based replacement

S&T Major Efforts include:

- High Maintenance Component Usage Sensing
- Diagnostic Evaluation of Usage Data
- Prognostic Determination of Imminent Component Failure

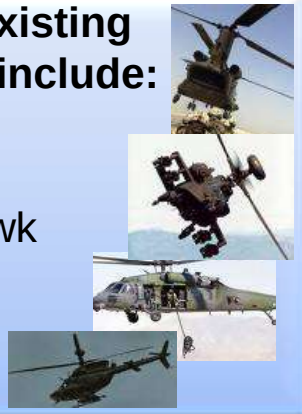
Near-term Goals:

- Lightweight non-intrusive component sensing devices
- Diagnostic methods for identifying part behavior anomalies
- Prognostic methods for predicting remaining part life and alerting to imminent part failure

Mid/Far-term Goals:

- Demonstrate ability to accurately determine part removal based on condition rather than schedule – foundation of Condition Based Maintenance
- Demonstrate significant maintenance and part cost savings utilizing Condition Based Maintenance principals

Legacy/Existing Systems include:



- Chinook
- Apache
- Blackhawk
- Kiowa

Internal Stakeholders:

- AMRDEC
- ARL
- TARDEC

External Stakeholders:

- PEO-Avn, Platform PMs
- PM-ASE
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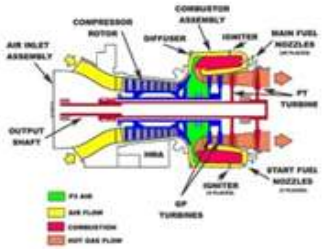
Operations & Sustainment Cost Reduction Technologies

Moving towards condition-based maintenance is a key element of reducing the high cost of ownership of our current rotorcraft fleet

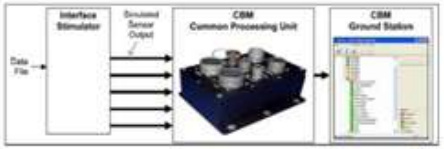
Propulsion

Bearing PHM
Erosion PHM
Rotating component RUL
Power management
Model-based torque analytic
Model Based Continuous power assurance



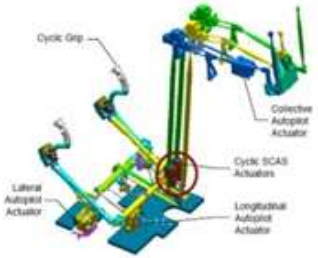
System Integration

Global Data Fusion
Integrated System Demonstration



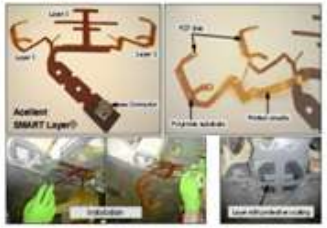
Flight Controls and Hydraulics

Mechanical controls/bearing prognostics
Pump and Actuator prognostics
Hose chafing detection



Structures

Fatigue damage detection
Ballistic damage detection



Drive System and Mechanical

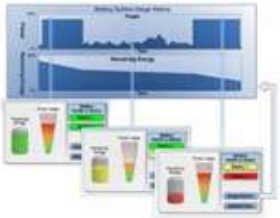
Planetary gear fault detection
Wear detection prognostics
Non-metallic debris monitoring
Corrosion detection
Wireless diagnostics module

Rotors and Dynamic Components

Hub component diagnostics
Blade damage detection
Usage monitoring-direct load measurement (yoke)
Usage monitoring-direct load measurement (pitch links, boost tubes, mast)
Simplified usage monitoring system

Electrical System and Wiring

Wiring prognostics/chafing
Electrical component prognostics



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Rotors & Vehicle Management Sub-Portfolio

Goal: Provide unmatched aircraft performance and agility with reduced aircrew workload under high stress flight operations

S&T Major Efforts include:

- High Performance Rotor Systems
- Intelligent Vehicle Control Functions
- High Fidelity Aerodynamics/Dynamics Analytic Methods

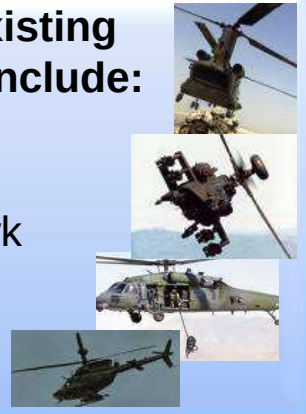
Near-term Goals:

- Integrate active control surfaces (flaps, slats, etc) onto rotor blades to enhance performance in all flight regimes
- Reduce workload of aircrew in low altitude, stressing flight operations

Mid/Far-term Goals:

- Increase the ability of the Vehicle management System to sense dangerous flight conditions and warn aircrew and/or take corrective action
- Increase analytic fidelity of aeromechanics methodology

Legacy/Existing Systems include:



- Chinook
- Apache
- Blackhawk
- Kiowa

Internal Stakeholders:

- AMRDEC
- ARL

External Stakeholders:

- PEO-Avn, Platform PMs
- G-3/5/7 Aviation, G-8
- Navy/USMC
- TRADOC

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Aircraft Weapons & Sensors Sub-Portfolio

Goal: Provide combat overmatch through the ability to see first and react first to enemy threats

S&T Major Efforts include:

- High Definition Helmet Displays
- Pilotage Sensors and Data Fusion
- Lethal and Non-Lethal Weapons Integration

Near-term Goals:

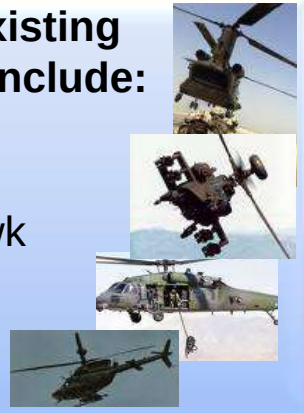
- Improved spatial resolution in helmet mounted displays
- Real-time image fusion and scene stitching to provide wide field of regard display
- Increased range of weapons options available to aircrews to defeat threats with minimal collateral damage

Mid/Far-term Goals:

- Air burst munitions to defeat threat manned and unmanned aircraft
- Demonstrate lightweight non-lethal weapons that can effectively disperse individual and group threats without collateral damage
- Multi function imagers for improved pilotage

Legacy/Existing Systems include:

- Chinook
- Apache
- Blackhawk
- Kiowa



Internal Stakeholders:

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- ARL
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- ARDEC

External Stakeholders:

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- Navy/USMC
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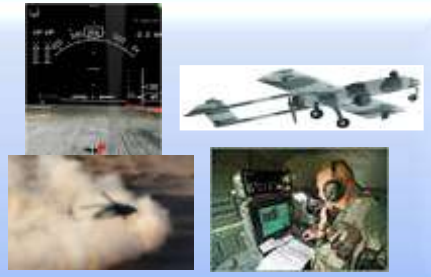
Unmanned & Optionally Manned Systems Sub-Portfolio

Goal: Provide innovative autonomous aviation systems to offload manned aircrew, and control logic to reduce workload to ground operators

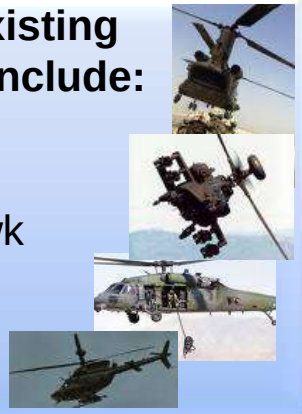
S&T Major Efforts include:
- Autonomous Cargo Resupply
- Display Symbology
- Multiple UAV Control
- UAV Sensor Packages



Near-term Goals:
- Reduced workload in the control of unmanned cargo resupply aircraft positioning and cargo release at objective location
- Aircraft display symbology that is conspicuous, intuitive and de-cluttered
- High resolution sensor suites for current Intelligence Surveillance Reconnaissance (ISR) mission UAV aircraft (Shadow, Grey Eagle)

Mid/Far-term Goals:
- Expand manned-unmanned teaming to incorporate more complex cooperative tactics
- Single ground operator control of multiple UAVs through increased autonomy and simplified tasking
- Next generation cockpit to integrate more off-board data feeds and improved mix of heads-up/heads-down displays

Legacy/Existing Systems include:
- Chinook
- Apache
- Blackhawk
- Kiowa



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Summary

- Portfolio supports the current and future fleet
- Major Efforts and Opportunities:
  - Advanced vertical take-off and landing platform technology
  - Degraded visual environment mitigation technology
  - Technology to reduce maintenance and sustainment cost

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WebPortal for Army wide Industry Engagement

Defense Innovation Marketplace

http://defenseinnovationmarketplace.mil/armyInformation.html

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Army Science & Technology

Providing Soldiers Technology Enabled Capabilities

MAINTAINING A LEADING EDGE IN TECHNOLOGY